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A QUICK ENERGY-SAVING RED STONEWARE CERAMIC ELECTRIC HEATING COOKER

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The present invention relates to an electric heating cooker, more particularly to a quick energy-saving red stoneware or ceramic electric heating cooker mainly heated by hot air.

A red stoneware ceramic cooker with an inner pot made of red stoneware or ceramics is particularly adapted as an electric rice cooler, water pot, soup pot, Chinese medicine healthcare pot, chafing dish, roasting pot and the like. These cookers are very popular for their special functions such as healthcare, health, sanitation, anti-sour, anti-spoilage, and make people apart from the potential risk of aluminum cookers. Accordingly, the processing and usage of aluminum are reduced and abolished eventually, which is benefit for environmental protection.

The inventor developed a red stoneware electric heating cooker in the 80's firstly. And it was the first time in the world to apply the red stoneware ceramics in an electric heating cooker successfully. With successive research and improvement, red stoneware ceramic electric heating cookers with various structures and heating modes were developed. Since the electric heating mode is limited due to the very low thermal expansion coefficient of red stoneware ceramics, it is difficult to increase heating power and elevate temperature high enough to make a soup boiling sufficiently. On the other hand, the inner pot is prone to crack. Chinese Patent No. ZL98243138.4 invented by the inventor of the present invention, entitled "an electric heating means of electric heating pot", discloses an open suspension type of electric heating tray, by which the conflict between higher temperature and crack of red stoneware inner pot was generally solved. In the prior art, the heating structure was usually so configured that a heating plate is generally mounted on the bottom for heating. This results in a non-uniform distribution of heat, and the electric heating plate will be deformed at a higher temperature, although higher heat efficiency might be achieved. On the one hand, the thermal expansion of the inner pot and the thermal stress among various pot parts are not matched. On the other hand, the heating element contacts the pot bottom directly. These will result in the crack of the inner pot. Furthermore, a desired temperature is also difficult to be controlled accurately. Chinese Patent No. ZL94211811.1 discloses "an electric heating ceramic pot", and it asserts that the electric heating ceramic pot could utilize heat sufficiently and save energy. In fact, it is difficult to be practically applied to products. Because the heating mode in this structure is accomplished by directly heat conduction between lateral heat reflective ring and shell, the shell temperature will be approximately the same as that of reflective ring as soon as heating. Therefore, the shell temperature is too high to be touched with hand (or scald hand if touching), so this structure is difficult to be applied to daily articles. Moreover, the temperature cannot be reached to a minimum temperature desired for cooking rice. In the prior art,

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the technical problems, such as non-uniform distribution of heat, crack of ceramic inner pot, difficulty of increasing heating temperature, inaccurate controlling of temperature by temperature-limiting means, early switch-off have not been solved thoroughly till now. This needs to overcome some technological bias to design a novel type of electric heating structure and heating mode.

The object of the present invention is to overcome the disadvantages in the prior art and to provide a quick energy-saving red stoneware ceramic electric heating cooker with advantages of high temperature, no crack of inner pot, uniform distribution of heat and accurate controlling of temperature.

The object of the present invention can be achieved by the following technical solution:

A quick energy-saving red stoneware ceramic electric heating cooker includes a cover 1, a red stoneware or ceramic pot 2, an outer shell 3, a base 3-1, a heating means and a temperature-controlling mechanism. A convective radiation sleeve 4 is provided on the inner side of the out shell 3, and a plurality of radiation persiennes 4-1 and air holes 4-2 are provided on the side wall of the radiation sleeve 4. Moreover, a plurality of larger air holes 4-3 are provided on its bottom plate. Obviously, an opening is provided at its center in order to mount a temperature-controlling element. A heating means is provided in the convective radiation sleeve, and it is an open heating means comprising an insulating sleeve 5, a heating element 6 and a heat conductive plate 7. The heat conductive plate 7 is provided on the bottom of the insulating sleeve 5 with its bending legs keeping a certain distance with the bottom plate. Furthermore, a plurality of air holes 5-1 are provided on the bottom of the insulating sleeve 5 corresponding to the air holes 4-3 on the bottom plate of the convective radiation sleeve. In this way, the air conduction between the bottom of the insulating sleeve and its outer side forces the hot air upwards. The electric heating element 6 exposes in air and abuts against the heat conductive plate 7 to conduct heat directly to heat conductive plate. An annular platform 7-1 is provided at the center of the heat conductive plate 7. Accordingly, the hole at the its center should be so large that a width of the gap between the edge of a temperature-controlling element 8 at the center and the edge of the hole in platform is in the range of from 2mm to 30mm in the horizontal direction. The platform should be sufficiently flat and has enough seal area to tightly contact the bottom of the inner pot 2 that is supported on it. Thus, hot air in the insulating sleeve cannot flow into the temperature-controlling element to ensure the accuracy of controlled temperature. The platform 7-1 and temperature-controlling element 8 as disposed in this way form the temperature-controlling mechanism. Platform has such a height that the vertical distance between the upper surface of electric heating element and the bottom of inner pot is more than 5mm. An inter-contact of them must be forbidden in order to prevent inner pot from overheating locally while ensuring the inner pot to be indirectly heated with hot air.

After the inner pot 2 is placed in the insulating sleeve 5 and supported on the platform 7-1, the gap between the sidewall of the insulating sleeve and the inner pot should be less than 10mm to define a smaller space between them as a high temperature chamber III, in which air is heated to a high temperature by the electric heating element. Hot air is then used to heat the inner pot 2. In this way, the heating temperature is increased, the heat conduction is accelerated, and the heat is distributed uniformly. The wall height of the insulating sleeve is equal to or less than the height of the inner pot, and the angle (β) between its sidewall and bottom is in the range of from 90 degree to 135 degree. Moreover, a hole 5-2 with a diameter larger than that of the temperature-controlling element is provided at the center of the insulating sleeve, and the hole has a ring of flange 5-3, in which the temperature-controlling element can move upwards and downwards.

The heat conductive plate 7 is provided with a ring of leg 7-2, and the height of the leg, that is, the distance between the lower surface of the heat conductive plate and the bottom, is maintained from 3 to 30mm. A plurality of holes or notches 7-3 are uniformly disposed in the leg to form air conduction. The angle (α) between a transition slop of the platform 7-1 and the level is in the range of from 20 degree to 90 degree. The width L of plane side of the platform is more than 5mm.

The sidewall of the convective radiation sleeve 4 has a plurality of radiation persiennes 4-1 and air holes 4-2, and the bottom also has air holes 4-3. Air flows through the insulating layer I between the radiation sleeve and the outer shell and through the insulating layer II between the convective radiation sleeve 4 and the insulating sleeve 5 to form air conduction, making the remaining heat in the outer shell gaps take away by air conduction in both the insulating layers. Hot air is so radiated from upper end that the temperature of the outer shell greatly decreases. However, hot air in a high temperature chamber III for cooking flows uniformly from the lower side to the upper side (indicated by arrow) whereby cooking heat may be distribute uniformly and utilized sufficiently to reduce heat loss and improve heat efficiency. It is desired that the distance between the convective radiation sleeve 4 and the insulating sleeve 5 is more than 2mm in order to make air in insulating layers convect sufficiently for radiation.

In regard to the platform 7-1 of the heat conductive plate, which forms the temperature-controlling mechanism with the temperature-controlling element, the gap between its edge and the outer edge of the temperature-controlling element maintains from 2mm to 30mm in the horizontal direction, and the width of the annular plane of the platform is more than 5mm to ensure a sufficient contacting seal area. The temperature-controlling element 8 is arranged on a mounting sheet 11 and is elastically biased on the bottom of the radiation sleeve 4 by a compression spring 12. The center hole 4-4 of the convective radiation sleeve, the center hole 5-2 of the insulating sleeve and the center hole 7-4 of the heat conductive plate are concentric. The holes are so large that the temperature-controlling element 8 may be freely move

therein and are free of contact with these parts. Therefore, temperature can be controlled more accurately.

The red stoneware ceramic electric heating cooker of the present invention has the following advantages:

1. The temperature and heat efficient being increased. By means of the open electric heating structure, the inner pot is indirectly heated by a hot air with a temperature of 430 °C, resulting in the increase of electric heating temperature, acceleration of heat conduction, uniform heating, uniform thermal expansion of the inner pot and elimination of thermal deformation stress. In a practical test, the red stoneware ceramic inner pot can be heated up to a temperature of 350 °C. The inner pot will not crack even though there is no water in it. Therefore, the long-standing problem for ceramic electric industry that red stoneware ceramic inner pot is prone to crack during heating is successfully solved.

2. By substitution of red stoneware ceramics for aluminum, a broad application of red stoneware ceramic articles is developed. A broad application of red stoneware ceramic cooker is based on the answer to the problem of the inner pot crack, i.e., no crack when heated up to 350 °C under a condition of no water therein. Assuming that 0.5 kilograms of aluminum in one aluminum heating plate and one kilogram in on aluminum pot are used, so the aluminum used in one cooker is weighed of 1.5 kilograms. Based on ten millions of cookers produced per year in our nation, the total weight of aluminum as used will be as high as 15 thousands tons. All these aluminum can be substituted by red stoneware ceramics. Furthermore, environmental pollution from aluminum work can be eliminated. In view of saving the material consumption and labors, 275 millions Yuan of RMB can be saved per year by substituting ceramics for aluminum.

3. Less heat loss and energy saving. Heat can be sufficiently utilized because heating is carried out by hot air in a smaller high temperature chamber for heating. Heating efficiency by using a heating element of 600 Watts of the present invention is higher than that by using a heating element of 700 Watts of the aluminum heating plate, resulting in saving 30-40% power.

4. Temperature difference in the inner pot being increased. With the electric heating cooker of the present invention, the temperature difference between the center and the periphery may be up to 65 °C after heating without water for 25 minutes, just like heating without water to crack. This is a unique characteristics of the electric heating cooker of the present invention.

5. Good convective radiation and the temperature of outer shell as low as that of not scalding hand. The present invention provides a reasonable convective radiation structure to ensure a good insulation and radiation. Additional useless heat will not

remain by convective radiation of two insulating layers, which greatly decrease the temperature of outer shell. In a practical test, temperatures on top of the outer shell, middle junction box and bottom plate are 87 °C, 80 °C and 60 °C, respectively. Therefore, heating is enhanced and convective radiation is improved. There is also no limitation to increase cooking temperature. Flavor rice, porridge and soup can be cooked.

6. Controlling temperature accurately. Temperature-controlling element cannot be affected by heating airflow in the scope of controlled temperature, resulting in controlling temperature accurately and not switching off too early. Accordingly, cooking effect can be ensured.

Brief Descriptions of The Drawings:

Figure1 is a structure view of the electric heating cooker according to the present invention and is used as the abstract drawing; Figure 2 is the partial cross-section view of the product of the present invention; Figure 3 shows the air convection; Figure 4 is the bottom view of the convective radiation sleeve 4; Figure 5 is the front view of the convective radiation sleeve 4; Figure 6 is the bottom view of the heat conduction plate 7; Figure 7 is the front view of the heat conduction plate 7; Figure 8 is the front view of the electric heating element 6; Figure 9 is the top view of the electric heating element; Figure10 is the top view of the insulating sleeve 5; Figure11 is the front view of the insulating sleeve; Figure12 is the structure view of the inner pot 2 and cover 1.

In the drawings: 1 - cover; 2 - red stoneware or ceramic inner pot; 3 - outer shell; 4 - convective radiation sleeve; 5 - insulating sleeve; 6 - electric heating element; 7 - heat conductive plate; 8 - temperature- controlling element; 9 - ceramic clamp; 10 - ceramic liner; 11 - mounting sheet; 12 - compression spring; 1-1 - air hole on cover; 3-1 - bottom plate of the outer shell; 3-2 - ear of the outer shell; 4-1 - air persiennes of the convective radiation sleeve; 4-2 - air hole; 4-3 - air hole; 5-1 - air hole in the bottom of the insulating sleeve; 5-2 - center hole; 5-3 - hole flange; 6-1 - connector; 7-1 - platform of the heat conductive plate; 7-2 - bend leg; 7-3 - notch in the bend leg; 7-4 - center hole in the platform. In Figure 3, arrows indicate the direction of hot air convection; α refers to the angle between a transition slop of the platform and the level; β refers to the angle between the sidewall and bottom of the insulating sleeve; L refers to the horizontal width of a plane side of platform.

Example: As shown in the drawings, the red stoneware ceramic electric heating cooker of the present invention includes a cover 1, an outer shell 3, a convective radiation sleeve 4, an insulating sleeve 5, a heat conductive plate 7, an electric heating element 6 and a red stoneware or ceramic inner pot 2, wherein the inner pot 2 is placed on the platform 7-1. A temperature-controlling element 8 is elastically mounted on the bottom by a mounting sheet 11 and a compression spring 12, and

placed at the center of various sleeves. The electric heating element 6 has its connector sealed by ceramic clamp, and has its bottom separated by a ceramic liner 10 in the radiation sleeve. After assembling, an insulating layer I is formed between the outer shell and the convective radiation sleeve; an insulating layer II is formed between the radiation sleeve and the insulating sleeve; a high temperature chamber for heating III is formed between the insulating sleeve and the inner pot. In this way, a quick energy-saving red stoneware ceramic electric heating cooker is formed.

Claims:

1. A quick energy-saving red stoneware ceramic electric heating cooker, comprising a cover (1), a red stoneware or ceramic inner pot (2), an outer shell (3), a bottom plate (3-1), a heating means and a temperature-controlling mechanism, characterized in that a convective radiation sleeve (4) is arranged inside of the out shell (3); in the convective radiation sleeve (4), an open heating means composed of an insulating sleeve (5), an electric heating element (6) and heat a conductive plate (7) are provided; a heat conductive plate (7) is placed on the bottom of the insulating sleeve (5); the electric heating element (6) exposes in air and abuts against the heat conductive plate (7); an annular platform (7-1) is provided at the center of the heat conductive plate (7); the platform (7-1) supports the inner pot (2) and abuts against the bottom of the inner pot; the temperature-controlling mechanism is composed of the platform (7-1) and a temperature-controlling element (8) at the platform center; the space between the bottom of the inner pot (2) and the electric heating element (6) is more than 5mm.

2. The quick energy-saving red stoneware ceramic electric heating cooker of claim 1, characterized in that the wall height of the insulating sleeve (5) is less than or equal to the height of the inner pot, and the angle (β) between the sidewall and bottom is in the range of from 90 degree to 135 degree; a plurality of air holes (5-1) are formed in the bottom of the insulating sleeve; the gap between the sidewall of the insulating sleeve (5) and the inner pot (2) is less than 10mm.

3. The quick energy-saving red stoneware ceramic electric heating cooker of claim 1, characterized in that the space between the bottom of the heat conductive plate (7) and the bottom of the insulating sleeve is in the range of from 3mm to 30mm; a plurality of holes or notches (7-3) are formed in the bend leg (7-2); the angle (α) between the transition slop of the platform (7-1) of the heat conductive plate and the level is in the range of from 20 degree to 90 degree.

4. The quick energy-saving red stoneware ceramic electric heating cooker of claim 1, characterized in that the sidewall of the convective radiation sleeve (4) has a plurality of persiennes (4-1) and air holes (4-2), and the bottom also has a plurality of air holes (4-3), aligned with the air holes (5-1) in the bottom of the insulating sleeve; the distance between the convective radiation sleeve (4) and the insulating sleeve (5) is more than 2mm.

5. The quick energy-saving red stoneware ceramic electric heating cooker of claim 1, characterized in that the width L of the annular plane side on the platform of the heat conductive plate included in the temperature-controlling mechanism is more than 5mm; the gap between the inner edge of the platform hole and the outer edge of the temperature-controlling element is in the range of from 2mm to 30mm in the horizontal direction